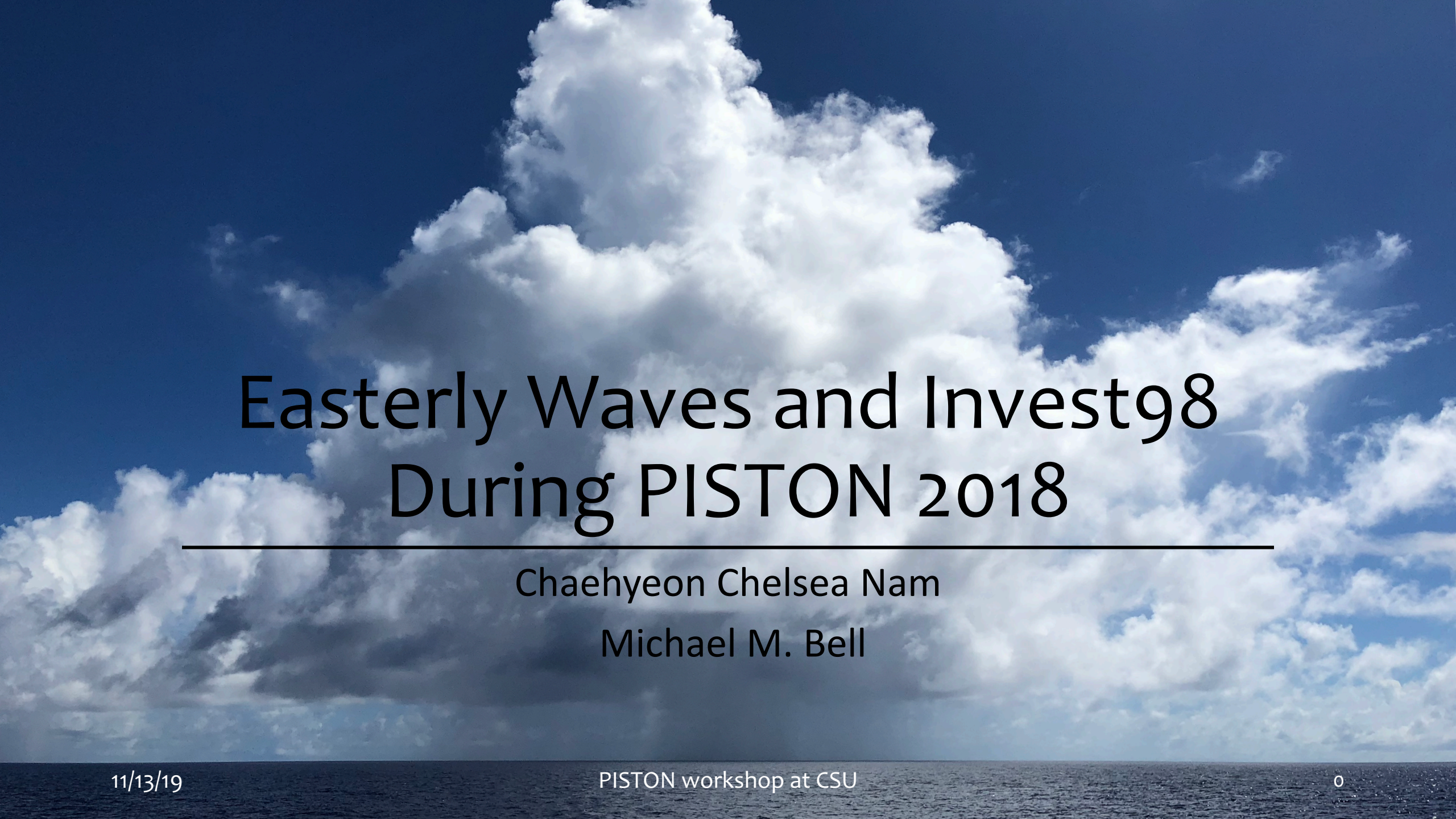
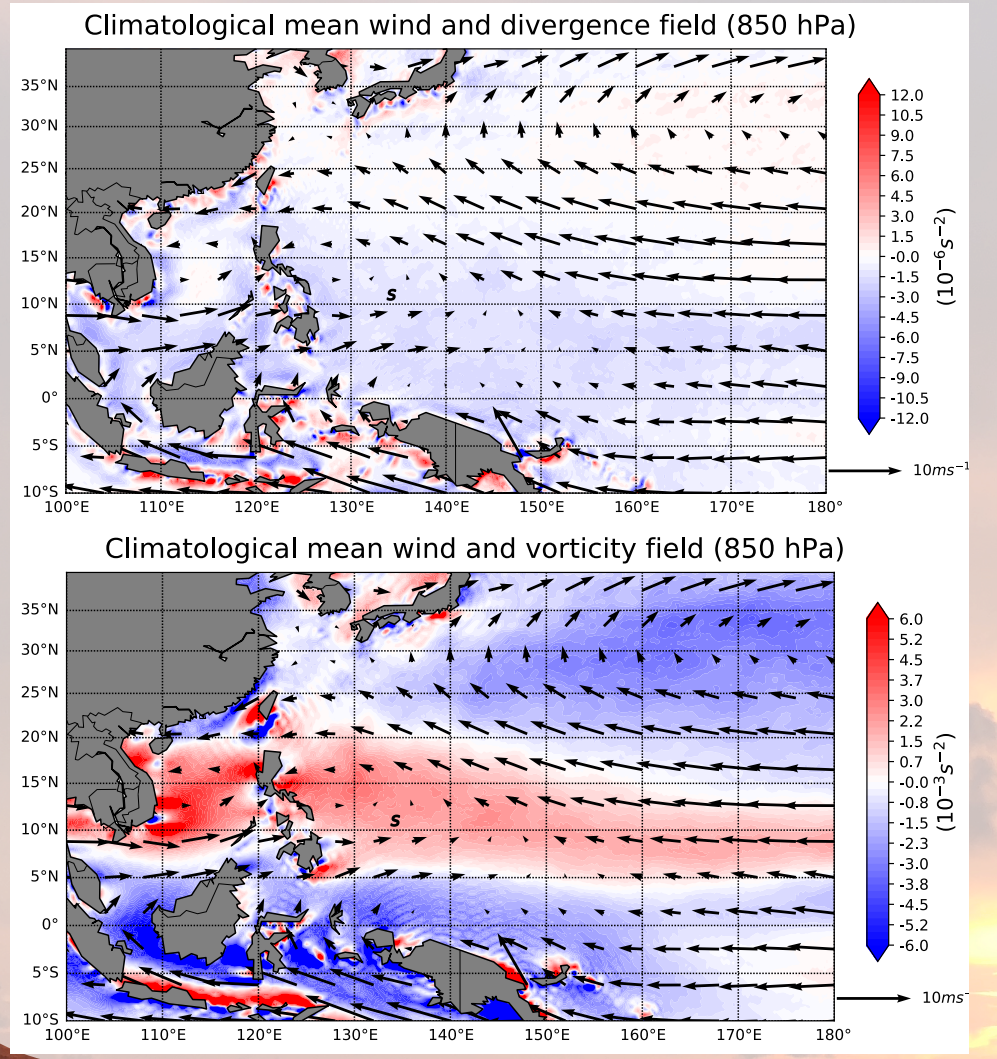


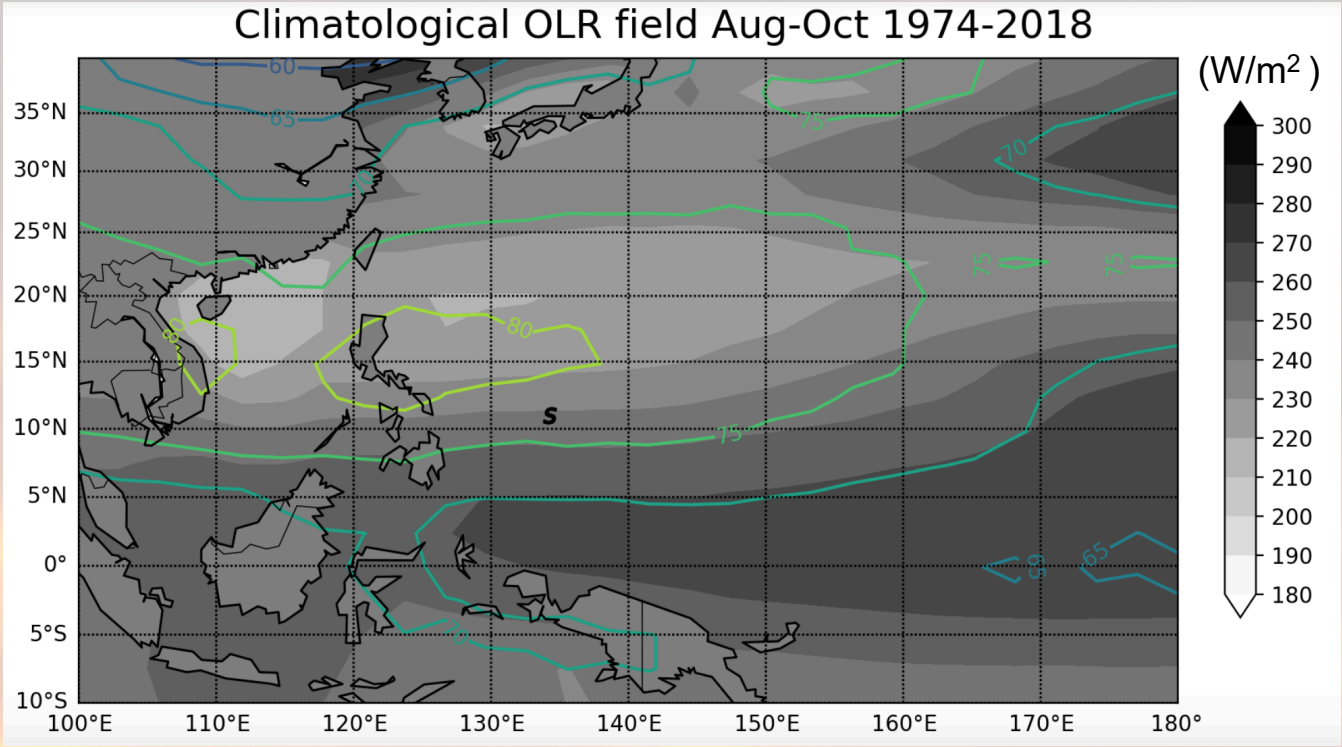
Easterly Waves and Invest98 During PISTON 2018

Chaehyeon Chelsea Nam

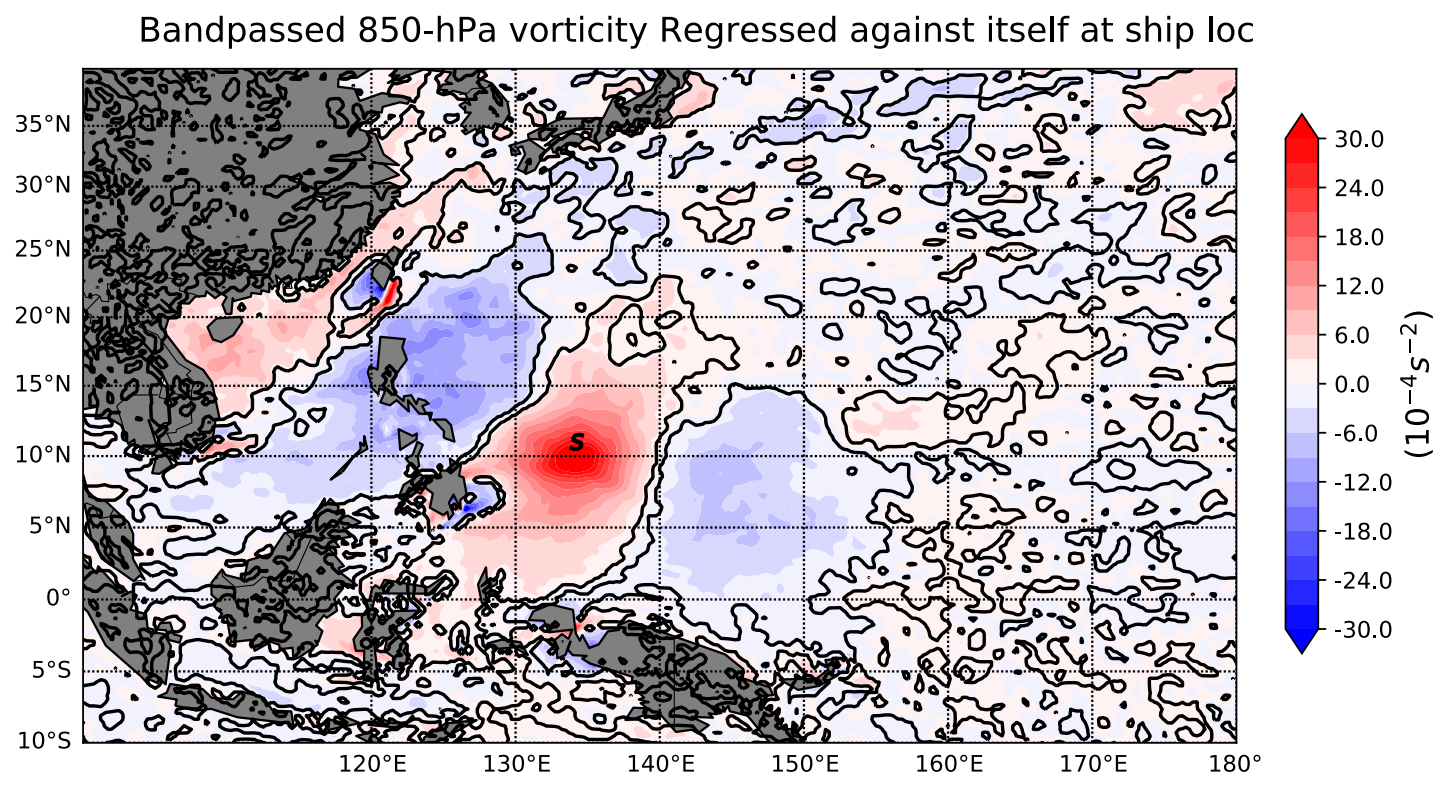
Michael M. Bell

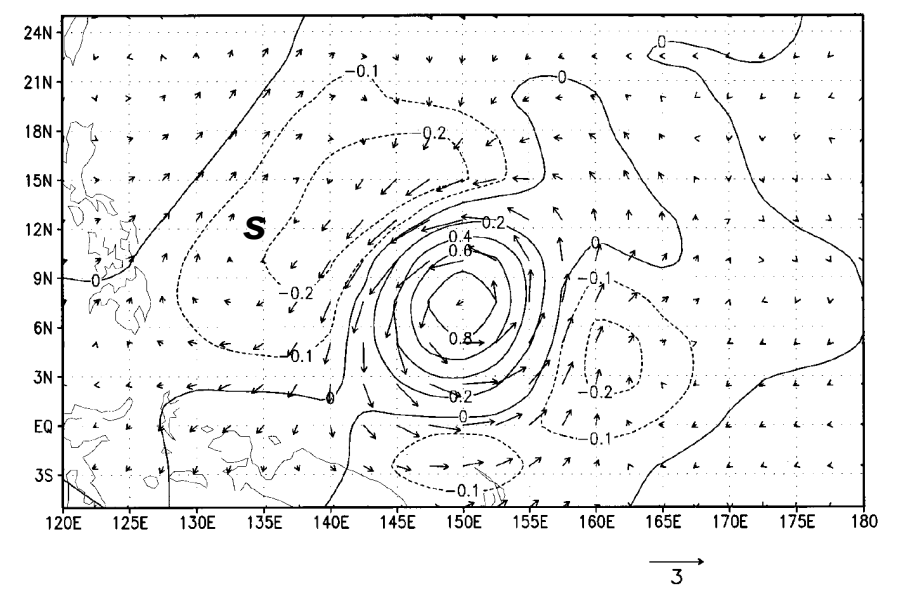
Climatology of wind and OLR





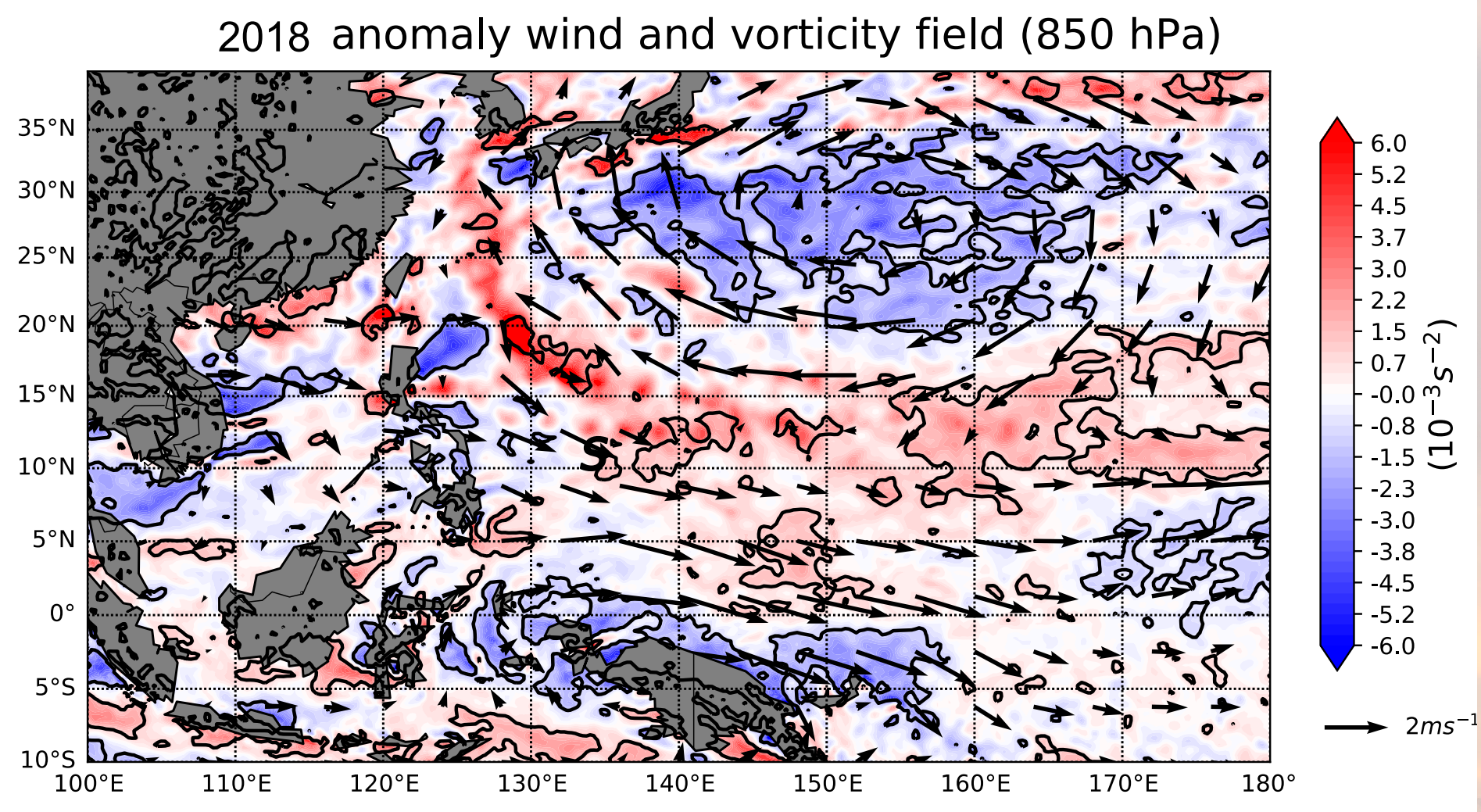
Climatological easterly wave over PISTON area





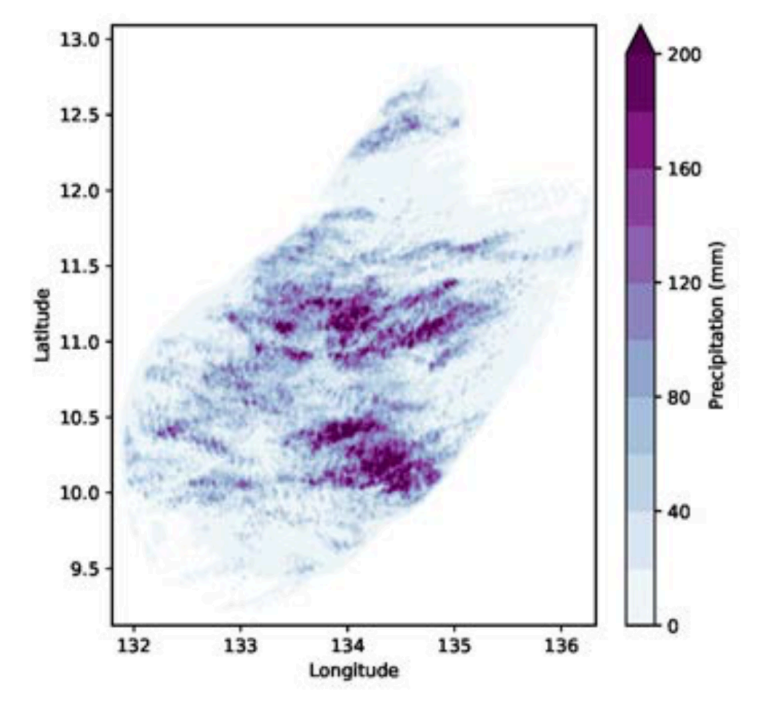
Sobel and Bretherton (1999) Fig.3

Easterly waves during PISTON 2018

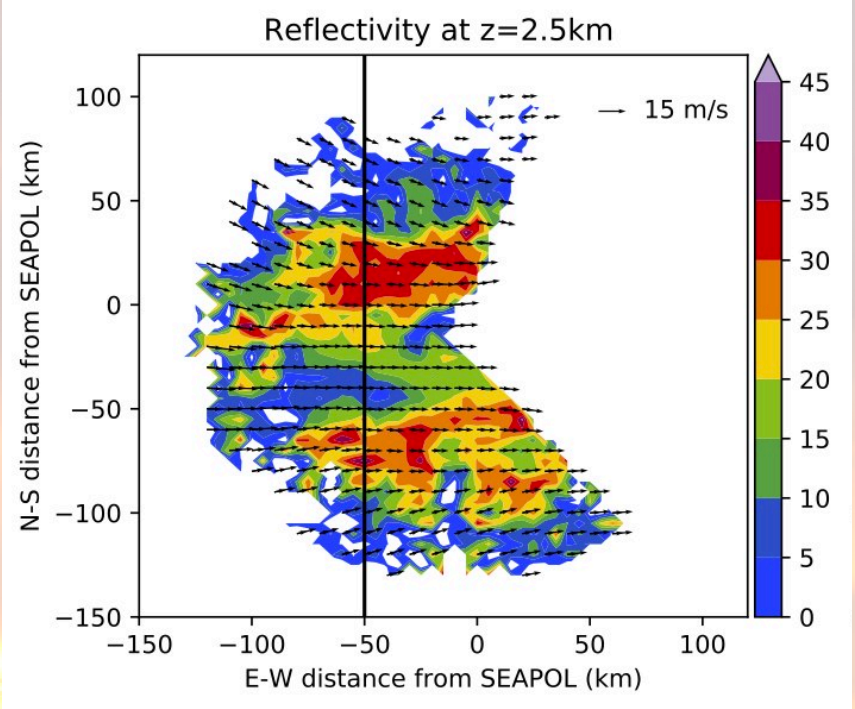


Invest WP98: Sea-Pol radar & Sounding

- Maximum 35-40 knot gust 0902-0904 soundings
- Over 200mm rainfall over PISTON domain



Courtesy of Scott Powell

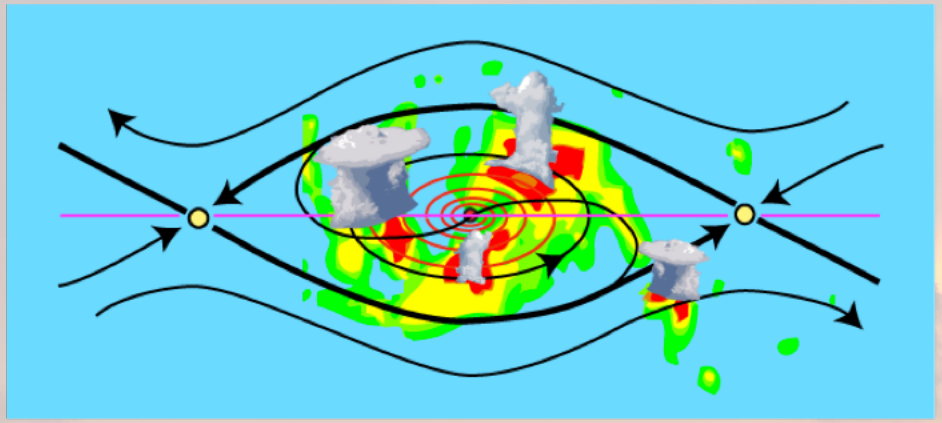


SAMURAI analysis with ERA5 background 0903 04Z

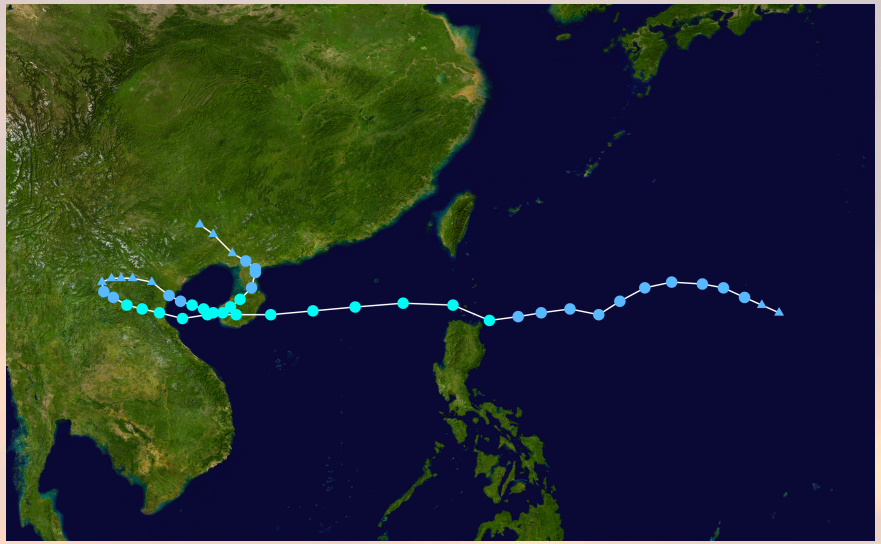
Scientific Questions

1. What can we learn about the precursor waves from this case study in terms of TC genesis?
2. Why didn't the Invest98 develop further?

Pouch Theory for TC formation



Dunkerton et al. (2009); Montgomery et al. (2012)

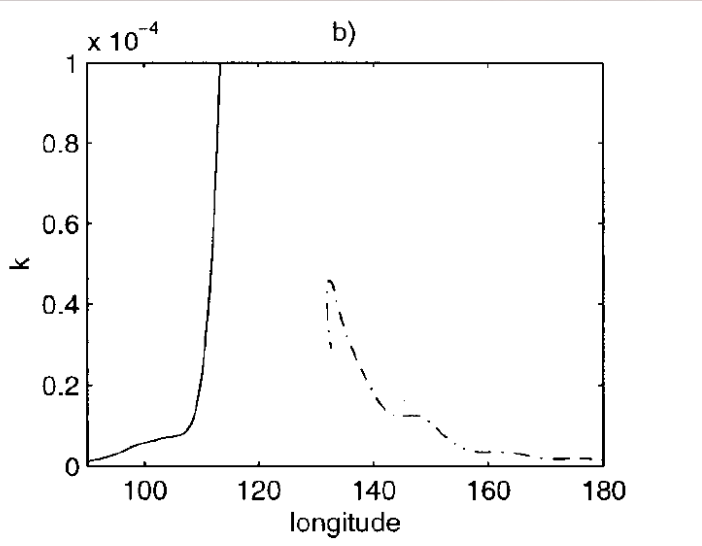


TS Son-Tinh (2018) developed into a TD at Jul 15 12Z after 48 hours of watching as Invest

Scientific Questions

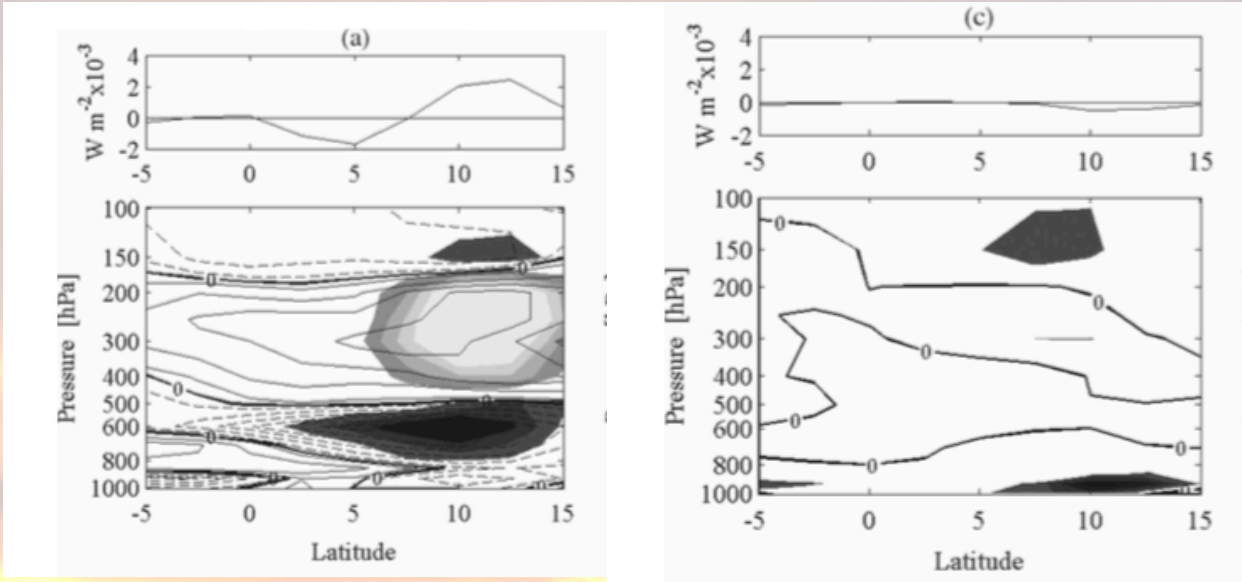
3. How did the vortex (pouch) develop physically?
   - How much of it was barotropic energy conversion (wave accumulation)?
   - And how much from diabatic heating?

Wave accumulation



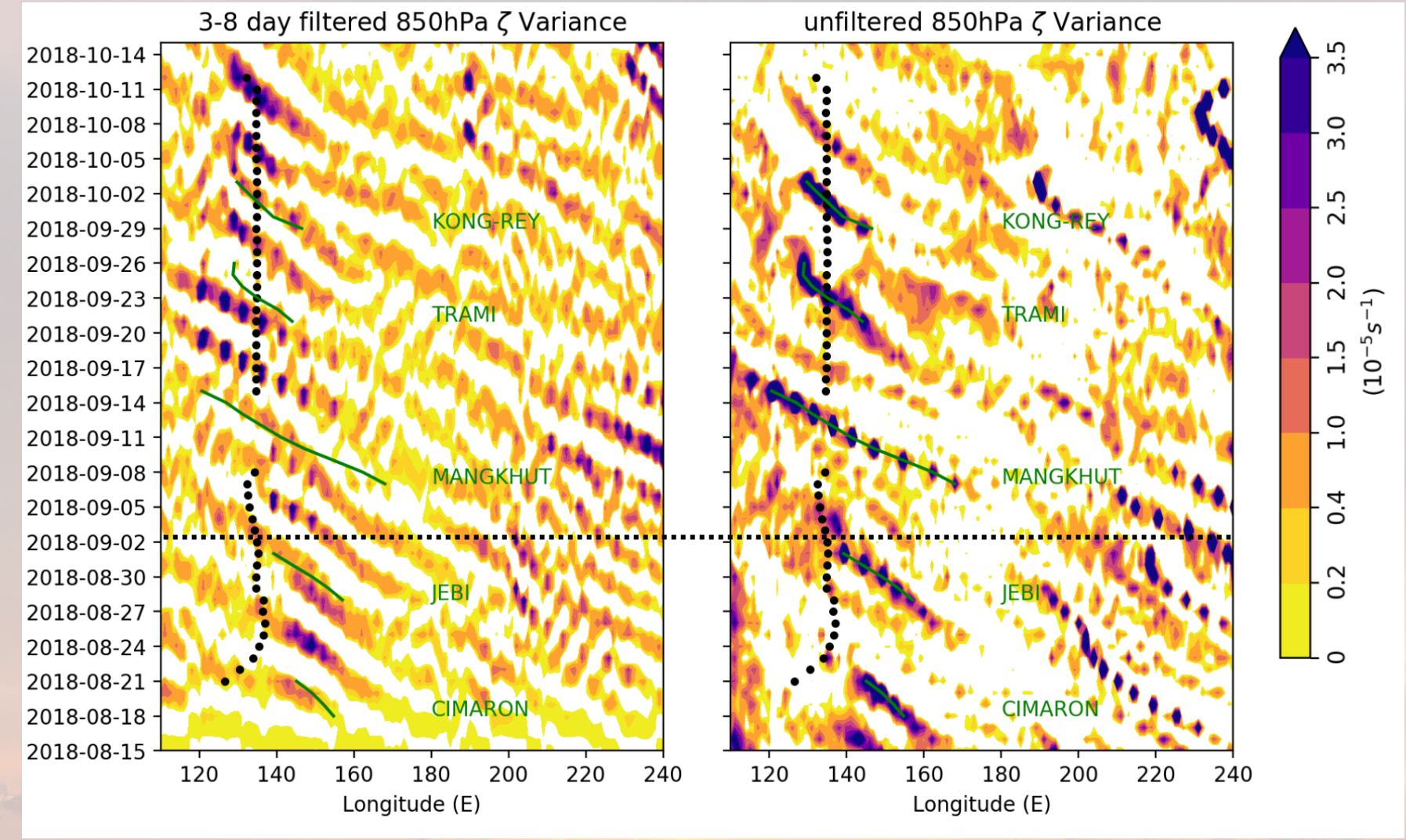
Sobel and Bretherton (1999) Fig. 7b

Diabatic heating vs. Barotropic Energy Conversion



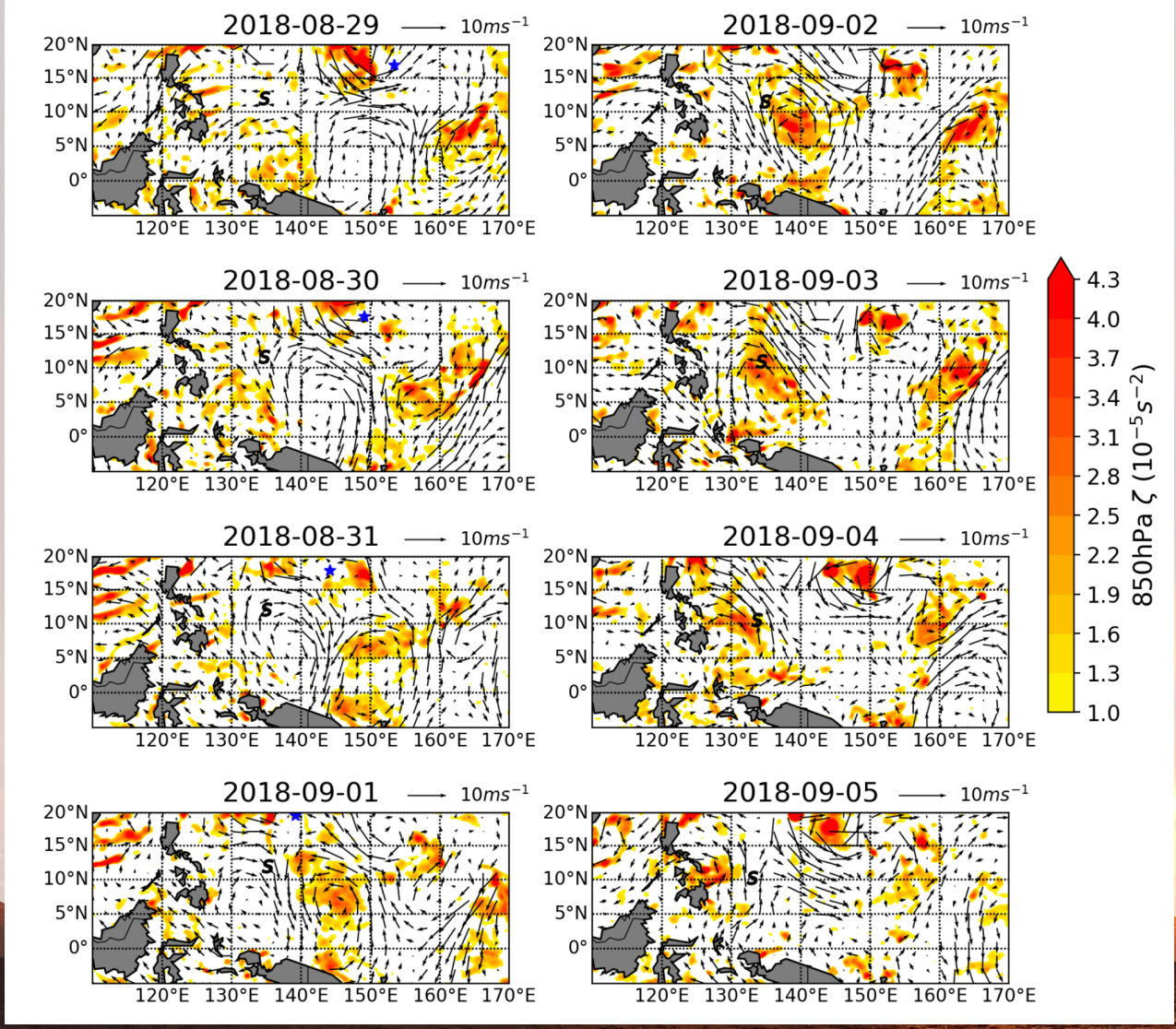
Serra et al. (2008) Fig. 12

Easterly waves during PISTON 2018

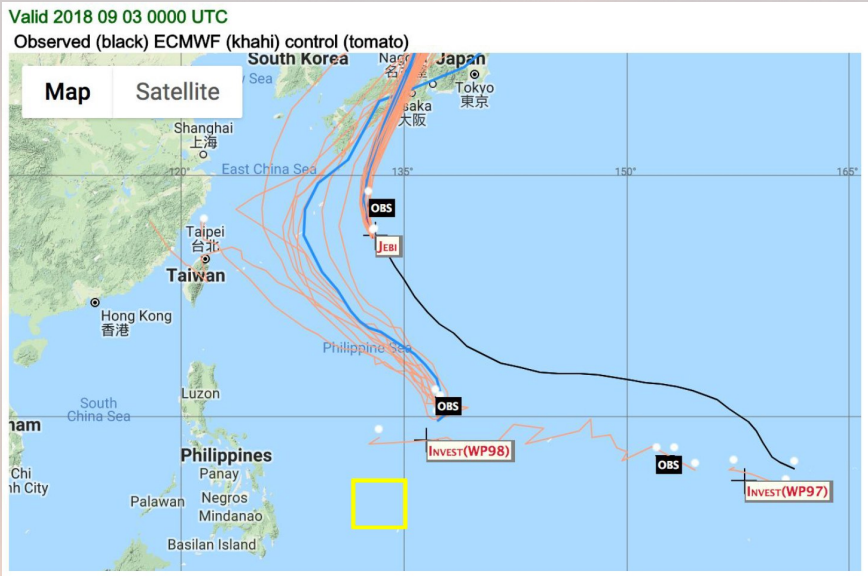


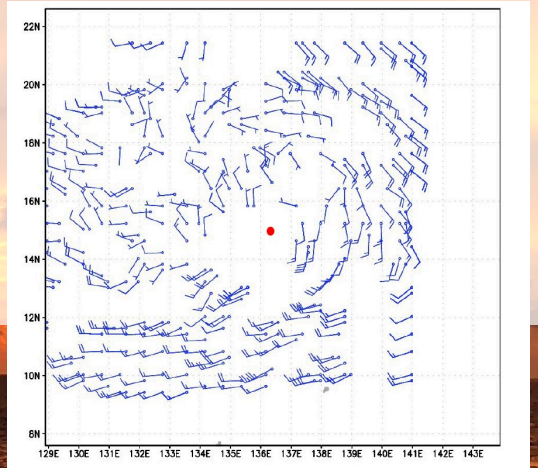
Invest98

3-8 day filtered vorticity and wind at 850 hPa



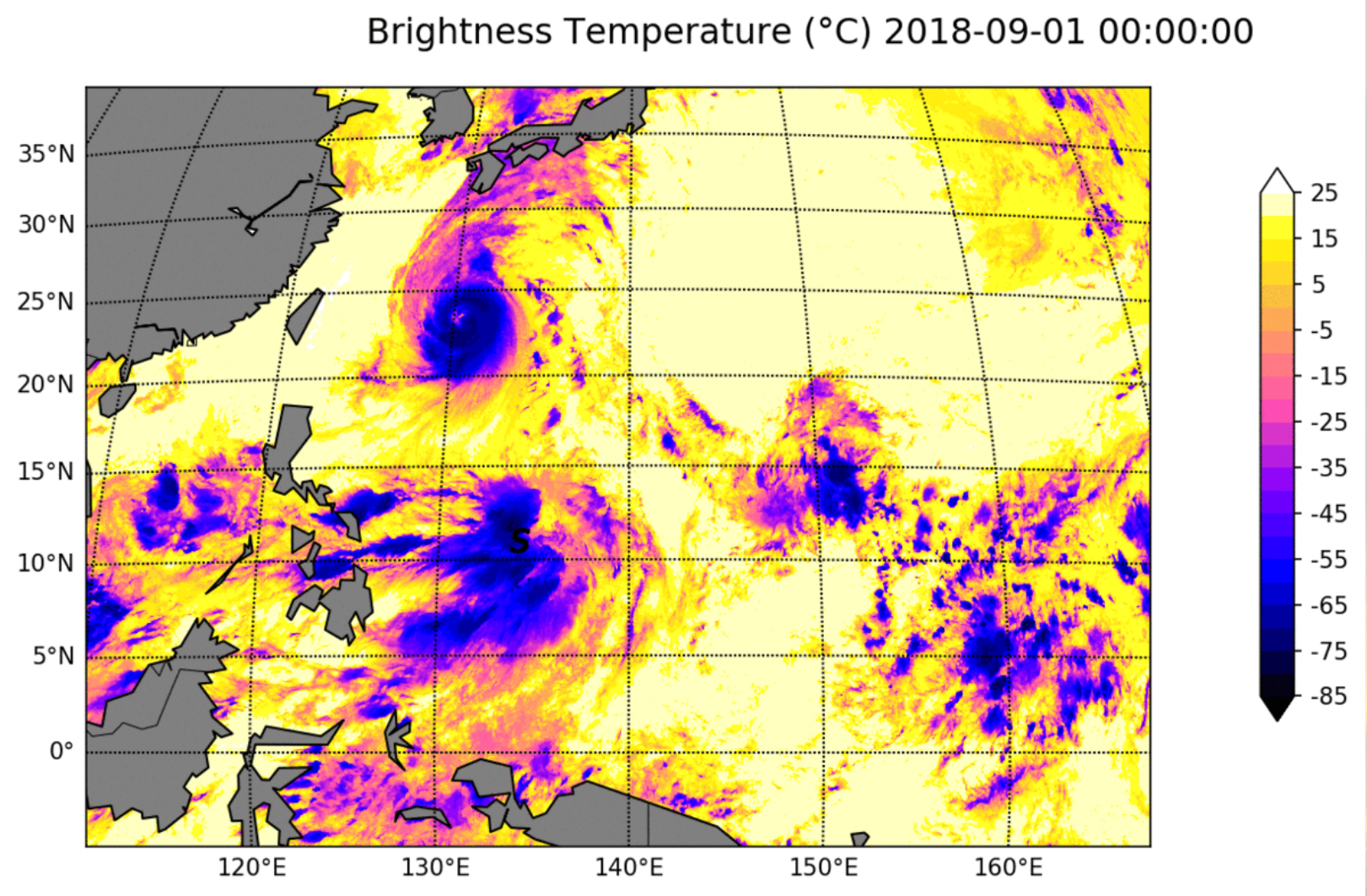
Invest98 track forecast from NOAA experimental product



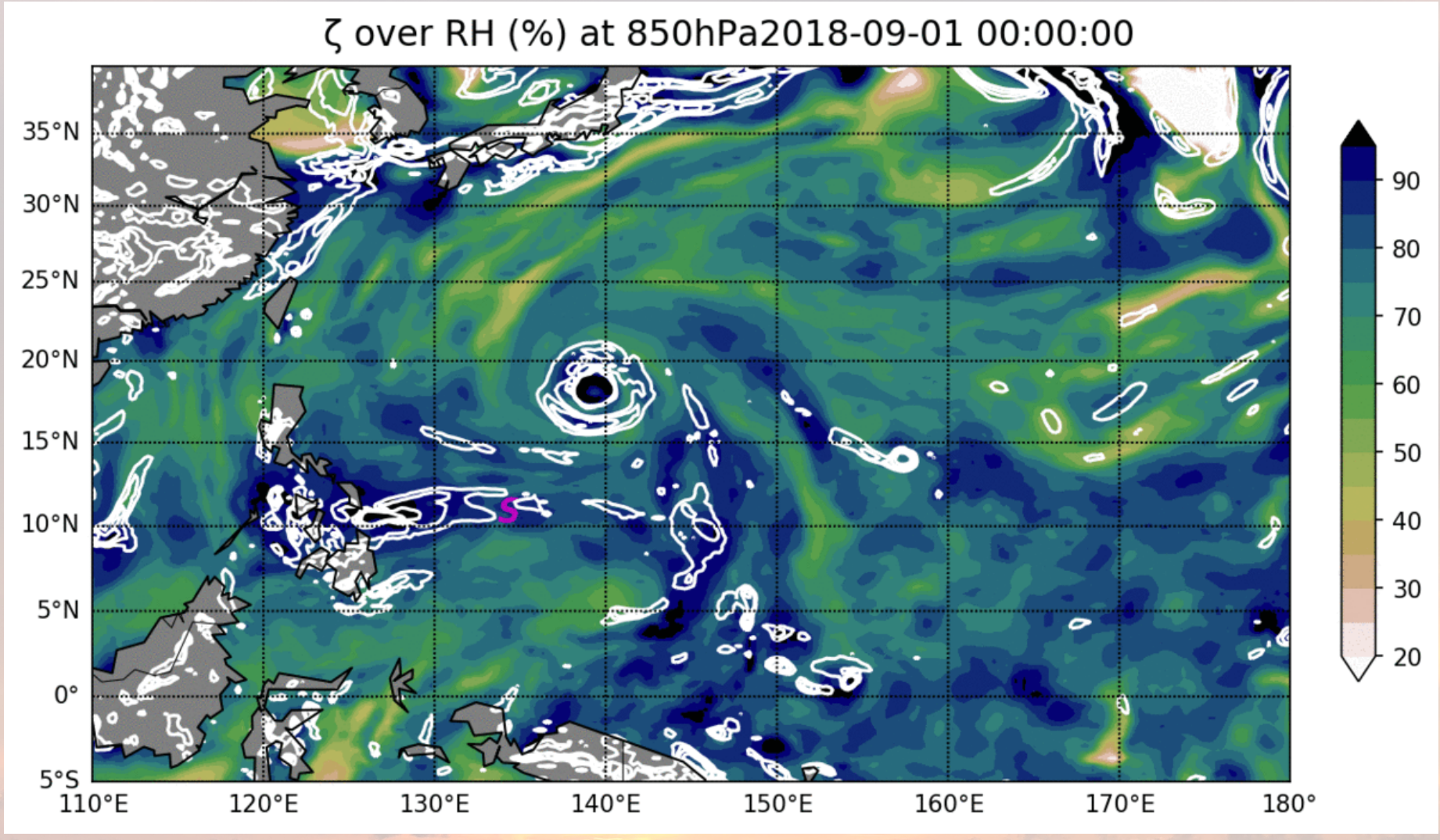


Invest98's closed low-level circulation

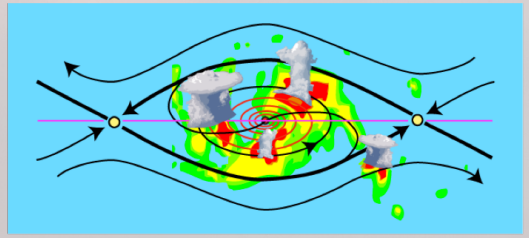
Invest WP98: Convection



Invest WP98: Vorticity & Relative Humidity



Wave Pouch Tracking: Invest 98



Dunkerton et al. (2009); Montgomery et al. (2012)

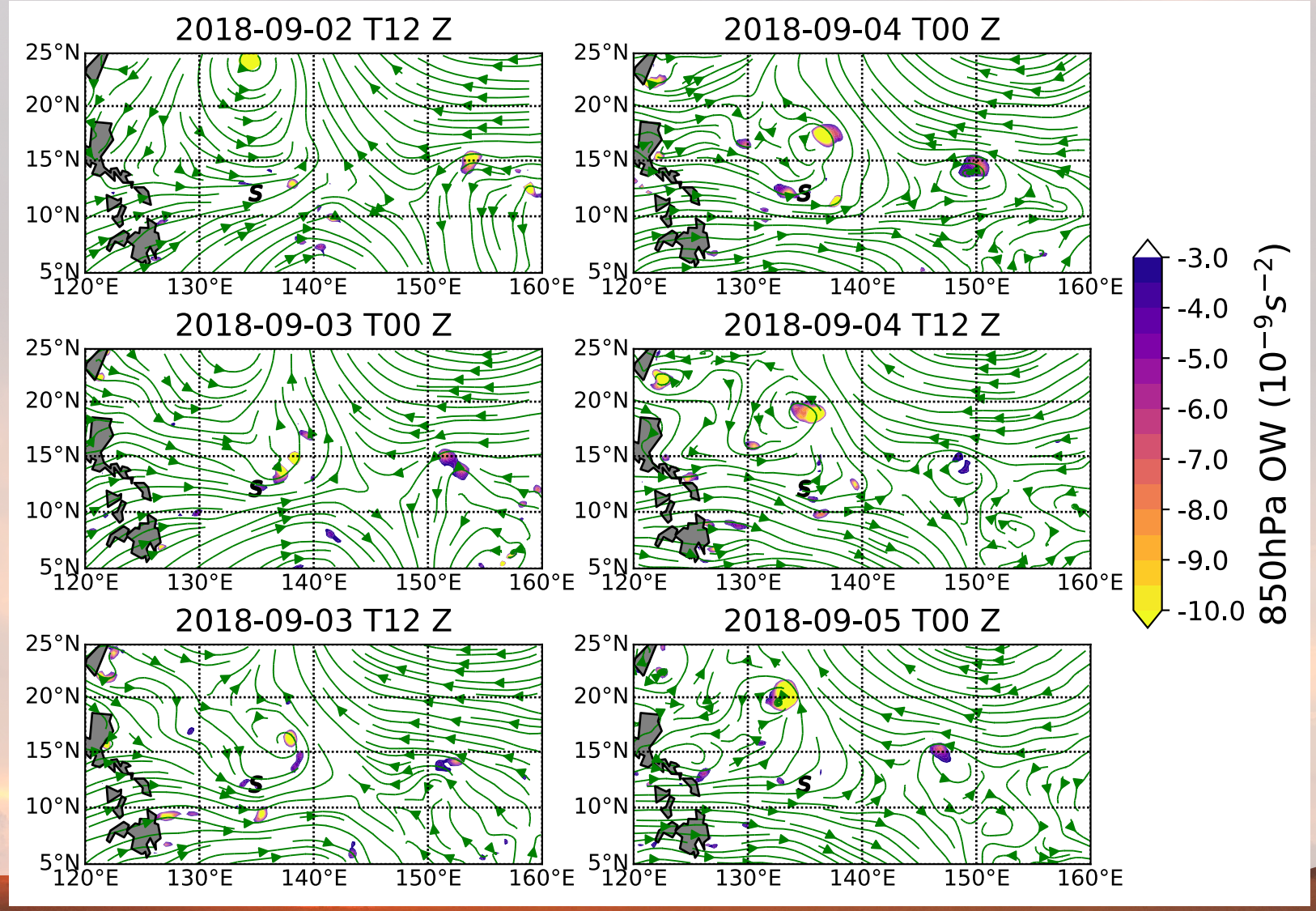
Okubo-Weiss parameter

$$W = s_n^2 + s_s^2 - \omega^2$$

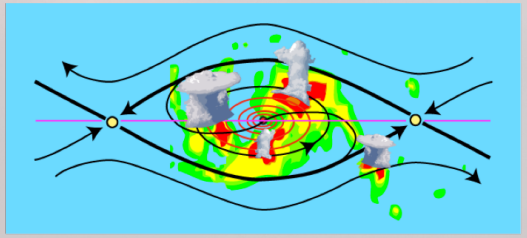
$$s_n = \frac{\partial u}{\partial x} - \frac{\partial v}{\partial y},$$

$$s_s = \frac{\partial v}{\partial x} + \frac{\partial u}{\partial y},$$

$$\omega = \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}.$$



Wave Pouch Tracking: TS Son-Tinh



Dunkerton et al. (2009); Montgomery et al. (2012)

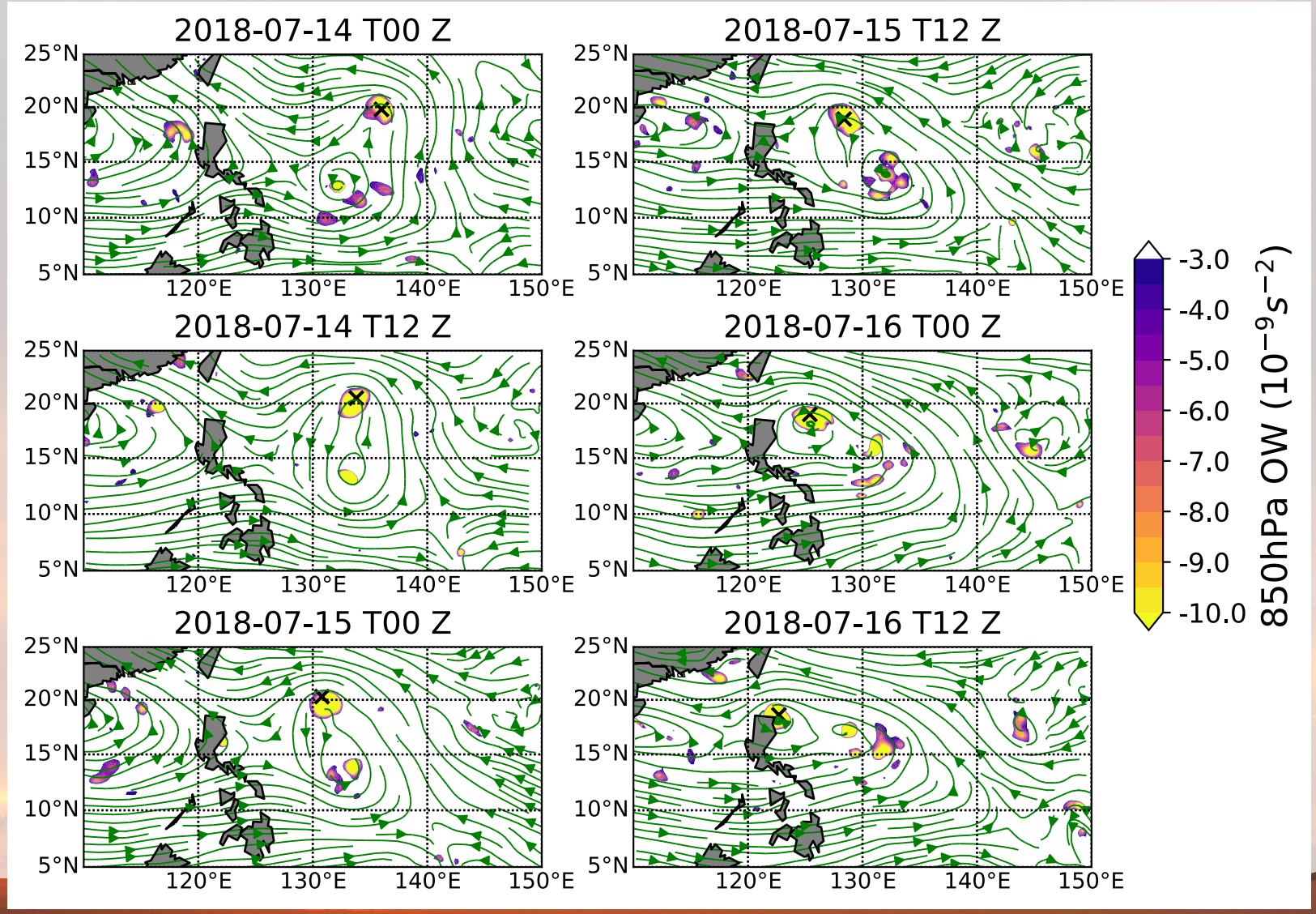
Okubo-Weiss parameter

$$W = s_n^2 + s_s^2 - \omega^2$$

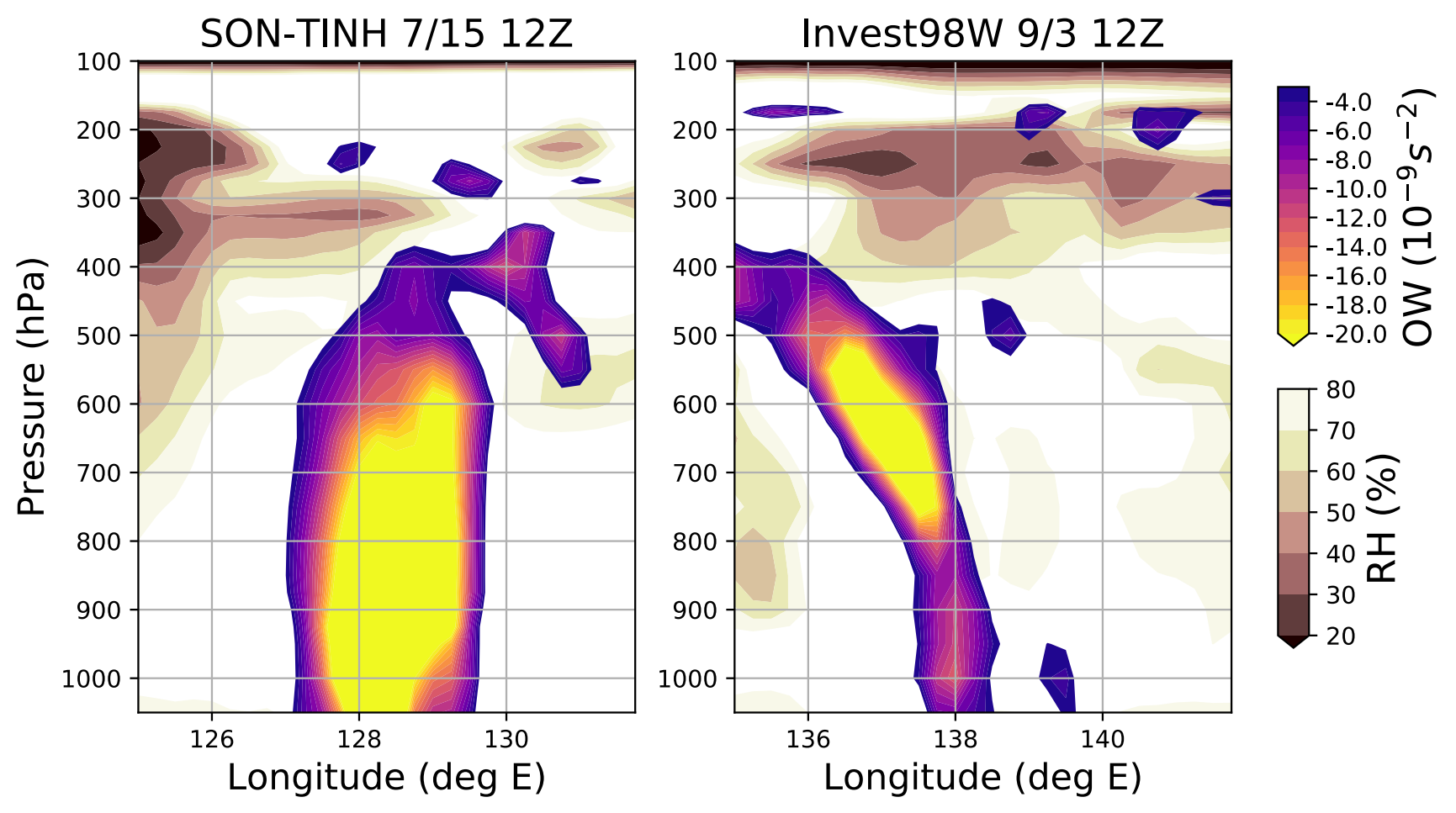
$$s_n = \frac{\partial u}{\partial x} - \frac{\partial v}{\partial y},$$

$$s_s = \frac{\partial v}{\partial x} + \frac{\partial u}{\partial y},$$

$$\omega = \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}.$$



Pouch Comparison: Son-Tinh vs. Invest98



Summary of preliminary results

- PISTON 2018 saw enhanced seasonal vorticity anomaly over western North Pacific that supports easterly wave propagation
- Invest98 is trackable in 3-8 day bandpass filtered vorticity field and had a low-level closed circulation (i.e. “pouch”)
- Invest98 produced more than 200mm rain over Sea-Pol: Convective systems ranging from isolated to linearly organized MCS

- Why didn’t the Invest98 develop further?

  Weak low-level vortex that was strongly tilted in the vertical and possible unfavorable interactions with Jebi outflow

Future plan

With this case study, we aim to learn more about ***the multi-scale TC genesis problem, bridging the gap between large-scale wave mode and meso-scale convection.***

1. Energetics budget analysis of Invest98
   - Following Sobel and Bretherton (1999) and Serra et al. (2008) but using the ship location and the PISTON time frame
2. Meso-scale pouch development analysis
   - WRF simulation
   - Link convective evolution to the strength of wave pouch (Sea-Pol reflectivity)

Thank you for your attention

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